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Modelling the Soviet Economy: SOVSIM at Five

This memorandum briefly reviews the use and structure of SOVSIM, the CIA's large econometric model of the USSR.   STAT
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This paper also reviews how realistic SOVSIM projections have been and what others have had to say about it.   STAT

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Introduction

1. Econometric modelling is a young discipline. The first serious efforts date from the 1950s; by the early 1960s, large scale models of the US and other Western economies were being developed. By the early 1970s, econometric models were accepted analytic tools in the West. STAT

2. Econometric modelling of centrally planned economies (CPEs) is more recent. For a number of years there was substantial concern over the applicability of econometric theory to non-market economies. These concerns were not removed until the mid-to-late 1970s when both Wharton Econometric Forecasting Associates (WEFA) and, somewhat later, CIA demonstrated the usefulness of econometric modelling in the case of CPEs. STAT

3. The CIA has played the dominant role in modelling the Soviet economy, STAT STAT By the early 1980s, Wharton and CIA had been joined by RAND and STAT others in modelling the USSR. STAT

SOVSIM in Overview

Purpose of SOVSIM

4. SOVSIM is a tool for studying the Soviet economy--its structure, internal linkages and growth prospects. Using information on the structure of the economy, resource availability and economic policies, the model can simulate the economy's operation and project its growth. It can be used to project where the economy is headed under recent trends or to examine the growth implications of prospective shifts in Soviet policies. This model was constructed primarily to make medium- to long-term projections--typically three to ten years beyond the current year. It also can be used to make short-term forecasts but they generally will not be as accurate as those available from alternative methods which rely more heavily on patterns in the last year or two. STAT

5. We have used SOVSIM since 1979 to estimate Soviet growth prospects. We have also used the model in numerous studies as a scenario analysis tool. In scenario analysis, the model provides an organized way of tracking the possible impacts on growth prospects of alternative Soviet or Western

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policies, or technological outcomes.

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Structure of the Model

6. The Soviet economy is the second largest in the world--some 140 million persons working at hundreds of thousands of locations to produce over 20 million different goods and services worth more than $1.5 trillion annually. SOVSIM describes only the most important general features of this economy. It aggregates all Soviet economic activities into 15 producing sectors, treating the output of each as a "single good" and then allocates this output to four major uses--defense, consumption, exports, and, through investment, future growth. (Figure 1)

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7. More specifically, SOVSIM consists of over 300 equations, each describing a particular facet of the Soviet economy. Some of these are merely definitional relationships. For example, the final relationship in the calculation of GNP is:

○   GNP is the value of the final goods and services produced annually by the various sectors of the Soviet economy.

Other equations express behavioral relationships among elements of the economy. An example is the relationship between inputs and outputs in each producing sector:

○   The value of output produced by a sector of the economy depends on the quantity of capital and labor used in that sector and the efficiency with which they are used.

The specific form of the behavioral equations has been estimated from relevant historical data by econometric analyses. Since each equation relates to a different economic variable, the model can provide calculations of more than 300 separate indicators of economic activities in the Soviet economy in each year for which the model is simulated.

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8. A basic equation describes how a particular component of the Soviet economy behaved historically. Projections using these basic equations show growth prospects assuming that past behavior will continue. Because all the equations are linked together in this calculation, the result is felt to be more realistic than a projection derived from single equations used on their own. As indicated above, besides developing in this way a baseline view of Soviet economic prospects, we can also alter the equations to reflect the impact of new policy initiatives or alternative technological outcomes and see how different our outlook for the future might become.

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9. The individual equations are grouped in SOVSIM according to the main components of the Soviet economy. On the resource input side we have a block of equations detailing the availability and use of labor and another block analyzing the flow of investment funds into capital formation. A separate block of equations lays out energy balances to allow for possible shortages that could constrain the use of capital stock. We also have three sets of

Figure 1

General Structure of SOVSIM

Producing Sectors

°   Agriculture

°   Industry

       Coal

       Gas

       Petroleum

       Electric Power

       Machinery

       Chemicals

       Ferrous Metals

       Nonferrous Metals

       Construction Materials

       Forest Products

       Consumer Goods

°   Construction

°   Transportation and Communication

°   Trade and Services

Uses of Output

°   Defense

°   Consumption

°   Future Growth

       (thru Investment)

°   Exports

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equation blocks focusing on the production process itself. In the agriculture block we look at likely output of grain, non-grain crops, and meat. Energy production is dealt with in a second block of equations, while other industrial production and services production relationships constitute a third block. International economic trade--with Eastern Europe, the West, and the Third World, as well as financial flows and debt--are treated in a separate block. Finally, we pull all of the production and trade results, along with output use descriptions, into a set of national economic accounts which summarize the estimated performance of the economy.   STAT

10. Each of these blocks is related to one or more of the others reflecting the actual interrelationships that exist in the Soviet economy. This makes SOVSIM especially useful for studying how one aspect of the economy, say energy developments, might affect another, such as the hard currency payments position.   STAT

Dynamics of Model Interactions

11. Figure 2 presents a summary flow diagram of the key elements and linkages in SOVSIM. A good place to start is to look at the flow of capital and labor resources (orange box) to the producing sectors (red box). SOVSIM estimates the number of workers, the stock of capital and the quantity of energy available to each sector of the economy. Some machinery may be idled by insufficient energy supplies. The available labor and utilized capital are then converted into goods and services measured in ruble terms through mathematical equations called production functions.   STAT

12. SOVSIM then allocates the goods and services available to the economy (green box):

°   Some are used for defense.

°   Some are invested in either new construction and machinery or repairs to existing facilities.

°   Some are exported to pay for imports or reduce foreign debt.

°   What is left goes to consumers.

Output from the machinery sector is especially important because it includes weapons for defense, durable goods for consumers, and equipment for investment.   STAT

13. Foreign trade and finance (blue box) has become an important part of the Soviet economy. Some domestically produced goods are sold to other countries. In return, the Soviet Union receives other products and services that it uses either directly in consumption, defense or investment, or indirectly through other production. Exports to and imports from hard currency countries along with other financial transactions determine the Soviet hard currency payments and debt position.   STAT

Figure 2
Summary SOVSIM Representation of the Soviet Economy
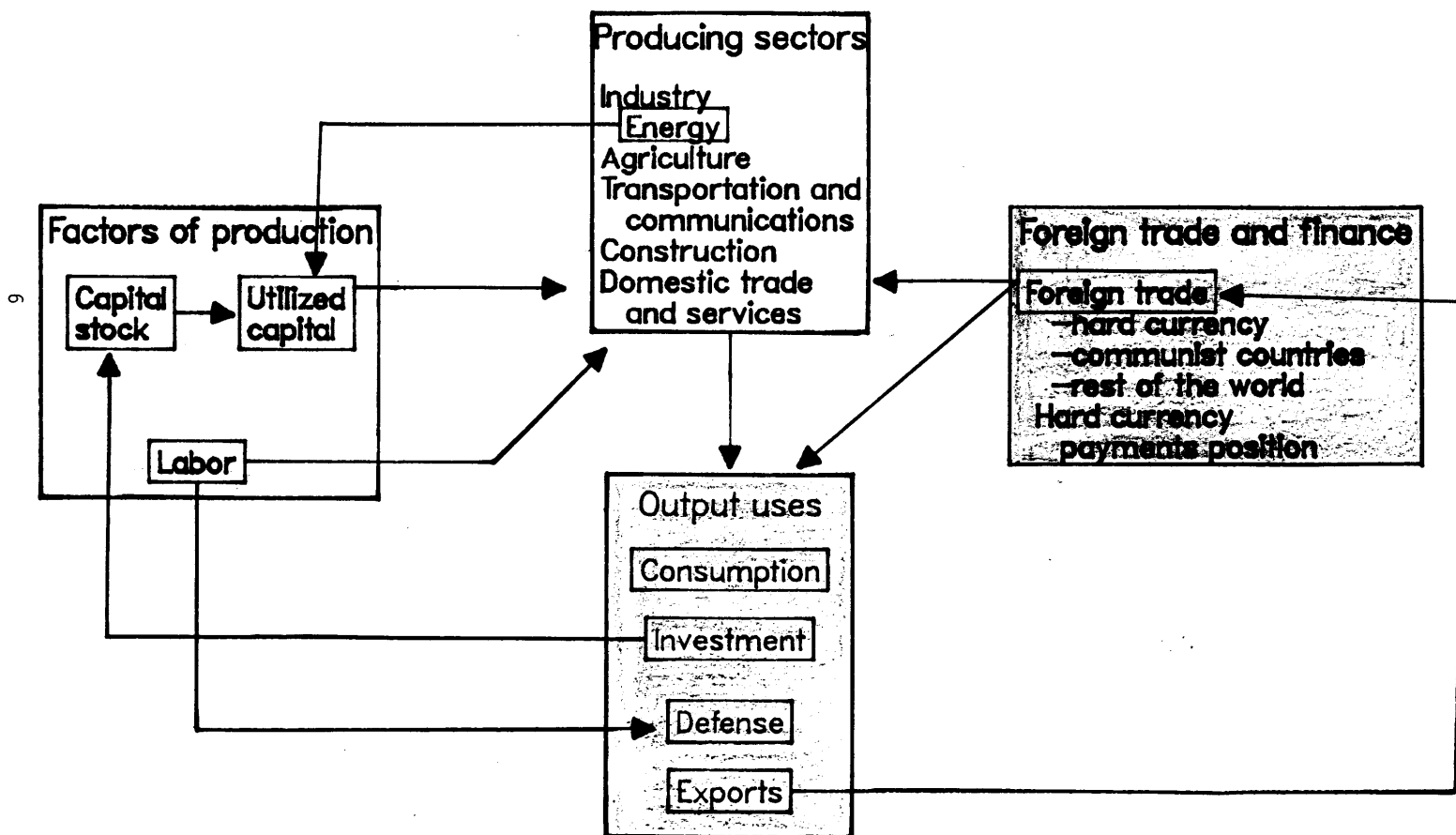
14. SOVSIM is useful as a tool for analyzing growth prospects because it captures the dynamic relationships in the Soviet economy. Investment may require several years to become capital available for production. Changes in labor supply also take time. Soviet policies themselves can change over time. The model describes the flows of resources and outputs over a number of years, each linked in time to activities in previous years. The calculations in turn provide a snapshot of the economy's future performance in each year.

Data Underlying the Model

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15. All econometric models require two types of data. Historical time series are used to estimate the nature of behavioral relations, such as how capital and labor have combined to produce output. This is a fairly straightforward, technical task. But all models also require information on how certain future events will play out. This is a much more difficult enterprise.

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16. There are differing degrees in the certainty that can be attached to these data on the future. Our estimates of labor force growth are relatively firm, for example, because all the people who will start working during the projection period can already be identified in existing population data and we have good information on mortality and participation rates. At the other end of the certainty spectrum is the distribution of GNP among primary uses-- consumption, investment, defense, and exports. Although there are obvious rigidities here, this distribution is ultimately subject to the policy choices of Soviet leaders. Therefore the values describing future levels of defense spending and investment that we must develop and put into the model are analytic assumptions on our part, which may be subject to substantial revision as events unfold.

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17. In general, we have more certainty about input values that are subject to little, if any, manipulation through policy or are clearly reflections of long-term trends that are not likely to be reversed quickly. We have less certainty about things that can be strongly influenced by such factors as policy decisions and international market forces. One reason for looking at alternative GNP projections is to gauge how sensitive the values generated by the modelling process are to some of the more important uncertainties in the input variables.

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Uses and Evaluations

SOVSIM's Track Record

18. Over the past five years SOVSIM has been used extensively both to provide a complete, integrated baseline view of Soviet economic prospects and to evaluate the implications for the economy of alternative Soviet and Western policies.

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We have also used SOVSIM to evaluate the impact on the Soviet economy of Western policy options such as grain embargoes, energy equipment embargoes, and credit restrictions.

19. Another type of analysis we've conducted focuses on quantifying the uncertainty in our outlooks. For example, much has been written on prospects for Soviet oil production, and we have used SOVSIM to analyze the implications of alternative levels of oil production for the economy. The results of such analysis enable us to link alternative oil production levels to specific economic growth rates, hard currency trade balances, and other economic indicators. This in turn allows us to distinguish between oil prospects which would severely impact on economic growth and those whose negative consequences could probably be contained fairly easily. In sum, then, SOVSIM has proven to be quite versatile in terms of the range of issues it can be used to explore.

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20. We believe SOVSIM's track record in forecasting basic Soviet economic trends is very respectable.

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Table 1
USSR: Average Annual Growth Rates
For Major Economic Indicators

	Projection for 1981-85 Made in			Percent Actual
Economic Indicator	1979	1982	1984	1981-83
GNP	2.5	2.1	2.4	2.5
Industrial output	3.0	2.0	2.3	2.7
Consumption	2.1	1.7	2.0	1.8
New fixed investment	2.4	1.1	3.2	3.3

21. In all cases, and despite very substantial changes in underlying economic assumptions, SOVSIM has been an accurate guide to the direction of change in growth rates between the 10th (1976-80) and 11th (1981-85) Five Year Plan periods. We correctly identified a slowdown in the growth rates of GNP, industrial output, consumption and new fixed investment. Our ability to foresee the absolute degree of change has varied but in view of significant changes in underlying assumptions, our estimates have been surprisingly robust.

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Comparision With Other Models and Forecasts

22. SOVSIM is different from economic models of Western, market-oriented economies. These focus on demand to determine levels of production, employment, and prices. In contrast, SOVSIM assumes that Soviet output levels are determined by resource availability and the efficiency of production processes. Demand is relatively unimportant because taut central planning ensures a perpetual state of excess demand. STAT

23. We have already noted that there are several other Western models of the Soviet economy. From time to time results from these models are compared with those from SOVSIM. The results of the work done by WEFA based on the best known of these other models, SOVMOD, have conveyed a more optimistic view than SOVSIM projections about the future of the Soviet economy. This difference stems primarily from several important differences in the assumptions about resource availabilities and how the Soviet economy operates. Compared to the CIA model, SOVMOD:

   ° Is slightly more optimistic about the growth of Soviet
      energy production and the Soviet ability to improve the
      efficiency of energy use.

   ° Calls for slightly faster growth of Soviet labor.

   ° Projects a more rapid growth of investment, partly because
      it foresees more rapid economic growth but also because it
      assumes that a slightly greater share of output will be
      devoted to investment.

   ° Credits production processes with greater productivity. STAT

24. As a result of these assumptions, SOVMOD projects that the Soviet economy will grow substantially faster than does SOVSIM. Further, SOVMOD even calls for growth rates in investment to be almost twice those required under Soviet plans. We believe this indicates that SOVMOD continues its historic tendency to be overly optimistic concerning Soviet economic prospects. STAT

25. Soviet economists also use models quite similar to SOVSIM and SOVMOD to examine their economy and estimate the structure of model relationships with the same statistical procedures used by Western economists. The primary difference is that the Soviets use their own data which we in the West believe can be misleading.[1] Nevertheless, much of their research is published, giving us a window on Soviet perceptions of their economy that can be used in conjunction with the results of SOVSIM. STAT

26. Similarities in the results from different models reinforce our conclusions about the Soviet economy. Differences, however, are not necessarily bad. They often simply reflect our limited knowledge about the

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Soviet economy. As such, they force us to reconsider our assumptions and
recheck our calculations. STAT

Outside Review

27. Peer review of SOVSIM is a critical element in our program to
maintain the quality of the Soviet modelling work. STAT

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we have had numerous outside experts review STAT
our work either in response to the need to evaluate a particular paper or as
members of a seminar group convened to discuss the work in broader terms. We
are firm believers in the need for and benefits of continual review. STAT

28. One of the most intensive forms of review is to have an independent STAT
group use our model. STAT

29. We also meet periodically with members of the WEFA staff to discuss
the SOVMOD and SOVSIM work programs. At these sessions we take particular
pains to delineate the differences between our estimates and, more
importantly, the underlying causes of those differences. Academic colleagues
are also called upon for continuing review of both the model and its
projections and have provided useful ideas for improving our work. STAT

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30. While various reviews have yielded literally dozens of specific
recommendations on ways to improve SOVSIM, none has questioned the basic
structure of the model. Often, reviewers have given us several ideas for
further research and modelling activities beyond the scope of SOVSIM itself. STAT

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